

**PATENT APPLICATION**

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re application of

Docket No: Q79258

Yasuo OKAMOTO

Appln. No.: 10/583,040

Group Art Unit: 1793

Confirmation No.: 6750

Examiner: Rebecca Y LEE

Filed: February 5, 2007

For: **METHOD FOR PRODUCING SHAPED ARTICLE OF ALUMINUM ALLOY, SHAPED  
ALUMINUM ALLOY ARTICLE AND PRODUCTION SYSTEM**

**DECLARATION UNDER 37 C.F.R. § 1.132**

Mail Stop Amendment  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Sir:

I, Yasuo Okamoto, hereby declare and state:

THAT I am a citizen of Japan;

THAT I am the named inventor of the present application;

THAT I am a graduate of the Graduate School of Engineering (Course of Metallurgical Engineering) for Education, University of Toyama and was awarded the degree of Master of Engineering on March 25, 1987;

That I have been employed by SHOWA DENKO K.K. since April 1, 1987 for 23 years in the Aluminum Sector SHOTIC Division Development Department, Research and Development.

The following experiments were performed by me or under my supervision.

Aluminum-shaped products employing the general production conditions set forth at page 44, lines 17 to 25 of the present specification were produced and tested. The Additional Tables below show (i) heat treatment conditions employed therein, percent reduction during the course of upsetting etc. (Additional Table 1), (ii) the compositions of the alloys employed (Additional Table 2), and (iii) the results of evaluation of the thus upset products (Additional Table 3).

The shaped products that were produced and tested are identified in the Additional Tables as Example 7-2, Example 7-4, Example 7-6, Additional Examples 1 to 4, and Additional Comparative Examples 1 to 3.

Examples 7-2, 7-4 and 7-6 are the same as the Examples 7-2, 7-4 and 7-6 set forth in the Appendix Tables 1 to 3 attached to the Amendment Under 37 C.F.R. § 1.111 filed on December 28, 2009.

I have included in the Additional Tables shown below the data for Examples 5 to 10, 12 and 16 to 23 of the present specification.

The Examples 5 to 10, 12 and 16 to 23 of the present specification, Example 7-2, Example 7-4, Example 7-6, and Additional Examples 1 to 4 shown below are encompassed by the scope of amended claim 1 of the present application.

I have not included in the Additional Tables shown below Examples from the present specification that are not within the scope of amended claim 1 and have not included Ex. 7-1, 7-3 and 7-5 from the Appendix Tables 1 to 3 attached to the Amendment Under 37 C.F.R. § 1.111 filed on December 28, 2009 which are not encompassed by the scope of amended claim 1.

Claim 1 as amended requires Ni in an amount of 0.8 to 3 mass% and P in an amount of 0.003 to 0.02 mass%. In addition, claim 1 recites a step of subjecting a shaped product to post-heat treatment, wherein the pre-heat treatment including treatment of maintaining the forging material at a temperature of 200 to 470°C for two to six hours.

I now explain Additional Examples 1-4 of this invention and Additional Comparative Examples 1-3 shown in the attached Tables.

Additional Examples 1-4 (shown as "Add. Ex. 1" etc. in the attached Tables):

The amounts of P and Ni contained in Additional Example 1 are the lower limits of the respective ranges defined in amended claim 1 of this application.

The amounts of P and Ni contained in Additional Example 2 are the upper limits of the respective ranges defined in the current claim 1 of the present application.

The amounts of Ni contained in Additional Examples 2 and 3 are outside the range disclosed by Sakamoto et al (JP 64-039339), that is, are outside the range of the amount of 0.3 to 2.0%, but are within the Ni range of claim 1 of the present application.

Further, the amount of P contained in Additional Example 3 is outside the range disclosed by Kamio et al (JP 2000-265232), that is, is outside of the range of the amount of 0.005 to 0.02 wt%, but is within the Ni range of claim 1 of the present application..

In summary, Additional Examples 2 and 3 are in the respective ranges of the amounts of Ni and P defined by amended claim 1 of the present application, but are outside one or more of the ranges disclosed in Sakamoto et al and Kamio et al.

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Additional Comparative Examples 1-3 (shown as "Add. Comp. Ex. 1" etc. in the attached Tables):

All of the Additional Comparative Examples 1-3 were produced at a temperature of 490°C for pre-heat treatment (the homogenization treatment), which is outside the range of the temperature for pre-heat treatment defined in amended claim 1 of this application, and is the minimum temperature disclosed in Kamio et al for the pre-heat treatment (homogenization treatment)..

Additional Comparative Example 1 does not contain P and Additional Example 2 does not contain Ni. Namely, Additional Comparative Examples 1 and 2 correspond to aluminum alloys disclosed by Sakamoto et al and Kamio et al, respectively.

Further, the respective amounts of Ni and P which Additional Comparative Examples 1-3 have correspond to the amounts of Ni and P of Examples 16 to 19 of the present specification.

Additional Table 1

	Pre-heat treatment (homogenization treatment)						Percent reduction during upsetting	Post-heat treatment (T6 treatment)		
	490°C	470°C	440°C	400°C	370°C	200°C or lower		Solid Solution	Quenching	Aging
Ex. 5	-	-	-	-	○	Room temp.	50%	○	○	○
Ex. 6	-	-	-	-	○	-	87.5%	○	○	○
Ex. 7	-	-	-	-	○	-	50%	○	○	○
Ex. 8	-	-	-	-	○	-	87.5%	○	○	○
Ex. 7-2						200°C	87.5%	○	○	○
Ex. 7-4	-	-	-	○	-	-	50%	○	○	○
Ex. 7-6	-	-	-	-	○	-	50%	-	-	○
Ex. 9	-	-	-	-	○	-	50%	○	○	○
Ex. 10	-	-	-	-	○	-	50%	○	○	○
Ex. 12	-	-	-	-	○	-	50%	○	○	○
Ex. 16	-	○	-	-	-	-	50%	○	○	○
Ex. 17	-	-	○	-	-	-	50%	○	○	○
Ex. 18	-	-	-	○	-	-	50%	○	○	○
Ex. 19	-	-	-	-	○	-	50%	○	○	○
Ex. 20	-	○	-	-	-	-	50%	○	○	○
Ex. 21	-	-	○	-	-	-	50%	○	○	○
Ex. 22	-	-	○	-	-	-	87.5%	○	○	○
Ex. 23	-	-	-	○	-	-	50%	○	○	○
Add. Ex. 1	-	-	-	-	○	-	50%	○	○	○
Add. Ex. 2	-	-	-	-	○	-	50%	○	○	○
Add. Ex. 3	-	-	-	-	○	-	50%	○	○	○
Add. Ex. 4	-	-	-	-	○	-	50%	○	○	○
Add. Comp. Ex. 1	○	-	-	-	-	-	50%	○	○	○
Add. Comp. Ex. 2	○	-	-	-	-	-	50%	○	○	○
Add. Comp. Ex. 3	○	-	-	-	-	-	50%	○	○	○

Additional Table 2

Compositional Proportions (mass%)													Metallographic structure
	Si	Fe	Cu	Mn	Mg	Ni	V	Zr	Ti	P	Sb	Sr	
Ex. 5	11.9	0.23	3.3		0.87	2.4	0.1	0.12		0.006			○
Ex. 6	do.	do.	do.		do.	do.	do.	do.		do.			○△
Ex. 7	12.8	0.49	3.8	0.23	1.09	2.0			0.1	0.009			○
Ex. 8	do.	do.	do.	do.	do.	do.			do.	do.			○△
Ex. 7-2	do.	do.	do.	do.	do.	do.			do.	do.			○
Ex. 7-4	do.	do.	do.	do.	do.	do.			do.	do.			○
Ex. 7-6	do.	do.	do.	do.	do.	do.			do.	do.			○
Ex. 9	13.4	0.61	4.1	0.32	1.21	2.2				0.01			○
Ex. 10	11.0	0.25	3.0	0.10	0.40	1.8				0.01			○
Ex. 12	11.8	0.33	3.3		0.72	2.2				0.005			○
Ex. 16	12.3	0.3	3.3	0.15	0.85	1.8			0.05	0.005			○△
Ex. 17	do.	do.	do.	do.	do.	do.			do.	do.			○
Ex. 18	do.	do.	do.	do.	do.	do.			do.	do.			○
Ex. 19	do.	do.	do.	do.	do.	do.			do.	do.			○
Ex. 20	12.8	0.45	3.8	0.25	0.9	2.1				0.01			○△
Ex. 21	do.	do.	do.	do.	do.	do.				do.			○
Ex. 22	do.	do.	do.	do.	do.	do.				do.			○△
Ex. 23	do.	do.	do.	do.	do.	do.				do.			○

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Additional Table 2 Cont.

													Metallographic structure
	Si	Fe	Cu	Mn	Mg	Ni	V	Zr	Ti	P	Sb	Sr	
Add. Ex. 1	12.3	0.3	3.3	0.15	0.85	0.8			0.05	0.003			○
Add. Ex. 2	12.3	0.3	3.3	0.15	0.85	3.0			0.05	0.02			○
Add. Ex. 3	12.3	0.3	3.3	0.15	0.85	2.2			0.05	0.003			○
Add. Ex. 4	12.3	0.3	3.3	0.15	0.85	3.0			0.05	0.004			○

Add. Comp Ex. 1	12.3	0.3	3.3	0.15	0.85	1.8			0.05	None			Δ×
Add. Comp Ex. 2	12.3	0.3	3.3	0.15	0.85	None			0.05	0.005			Δ×
Add. Comp Ex. 3	12.3	0.3	3.3	0.15	0.85	1.8			0.05	0.005			Δ×

Additional Table 3

300°C tensile characteristics					Eutectic Si			Intermetallic compound		
					Average particle diameter	Area share	Proportion of substances having acicular ratio of 1.4 or more (%)	Average particle diameter	Area share	Proportion of substances having length of 3 $\mu\text{m}$ or more (%)
	$\sigma_B$ (MPa)	$\sigma_{0.2}$ (MPa)	$\delta$ (%)	$\sigma_w$ (MPa)	( $\mu\text{m}$ )	(%)	(%)	( $\mu\text{m}$ )	(%)	(%)
Ex. 5	80	51	19.1	56						
Ex. 6	77	47	20.0	54						
Ex. 7	82	53	17.5	58	3.0	9.3	65.4	2.8	4.2	50.3
Ex. 8	79	50	18.9	56						
Ex. 7-2	83	54	17.1	45						
Ex. 7-4	80	50	17.4	43						
Ex. 7-6	85	52	15.0	51						
Ex. 9	85	56	16.8	60						
Ex. 10	77	48	18.2	51						
Ex. 12	81	50	17.6	57						
Ex. 16	72	42	23.4	48						
Ex. 17	74	45	21.8	50						
Ex. 18	76	47	19.2	52						
Ex. 19	77	49	18.4	53						
Ex. 20	75	45	22.0	49	3.1	9.7	45.2	2.7	4.3	40.5
Ex. 21	78	50	19.5	54						
Ex. 22	76	47	20.6	51						
Ex. 23	80	52	17.9	56						

The tensile test and fatigue strength tests at 300°C were performed after the test piece was preliminarily heated to 300°C for 100 hours.



Additional Table 3. Cont.

300°C tensile characteristics					300°C fatigue strength (10 <sup>7</sup> )
	σB (MPa)	σ0.2 (MPa)	δ(%)	σw (MPa)	
Add. Ex. 1	74	45	18.5	50	
Add. Ex. 2	84	57	16.7	58	
Add. Ex. 3	80	53	17.5	55	
Add. Ex. 4	82	56	16.5	57	

Eutectic Si			Intermetallic compound		
Average particle diameter (μm)	Area share (%)	Proportion of substances having acicular ratio of 1.4 or more (%)	Average particle diameter (μm)	Area share (%)	Proportion of substances having length of 3 μm or more (%)

Add. Comp Ex. 1	62	40	16.8	31
Add. Comp Ex. 1	57	38	40.6	33
Add. Comp Ex. 1	66	40	26.2	41


The tensile test and fatigue strength tests at 300°C were performed after the test piece was preliminarily heated to 300°C for 100 hours.

**Discussion of the Results**

Additional Tables 1 to 3 show the following facts about the effects depending on the temperature of the pre-heat treatment and the alloy composition.

Based on a comparison between Additional Comparative Example 3 and Examples 16 to 19, all of which examples had the same composition within the claimed Ni and P amounts of present claim 1, and differed only in the temperature of the homogenization treatment, it can be seen that the homogenization treatment at a temperature of 470°C or less leads to the production of a product having higher tensile strengths and fatigue strengths at 300°C than obtained at a homogenization treatment temperature of 490°C, which is the minimum temperature disclosed in Kamio et al for the pre-heat treatment (homogenization treatment).

Based on a comparison among Examples 16 to 19 of the present specification, it can be seen that the lower the temperature for homogenization treatment is, the higher the high-temperature tensile strength and high-temperature fatigue strength are, and that a similar tendency is found among Examples 20, 21 and 23.

As shown in Additional Tables 1 to 3, all of the Examples 5 to 10, 12 and 16 to 23 of the present specification, Example 7-2, Example 7-4, Example 7-6, and Additional Examples 1 to 4, which are encompassed by the scope of amended claim 1 of the present application have compositions within the Ni and P ranges of the present claims and were treated at a pre-treatment temperature within the range of the present claims, have higher tensile strengths and fatigue strengths at 300°C than Additional Comparative Examples 1-3 which either do not have the P or Ni content of the present claims (Additional Comparative Examples 1 and 2, respectively) or

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which were not treated at a pre-treatment temperature within the range of the present claims  
(Additional Comparative Example 3).

In my opinion, the advantageous effects depending on the temperature of the pre-heat treatment (homogenization treatment) for the alloy of the present invention and the alloy composition which are described above unexpected and are neither disclosed nor suggested in any of Kamio et al (JP 2000-265232) and Sakamoto et al (JP 64-039339).

I declare further that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Date: February 3, 2011

  
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Yasuo Okamoto